Letter to the Editor

Simulated net-benefit of polymerase chain reaction test for COVID-19 among asymptomatic patients

Dear Editor,

In order to prevent the in-hospital novel coronavirus disease 2019 (COVID-19) pandemic, some authorities have suggested that polymerase chain reaction (PCR) testing should be performed on all patients admitted to the emergency department, even if they are asymptomatic.[1] However, it is unclear whether this strategy is effective or not. Thus, our simulation study showed the circumstances and net benefits of performing PCR testing for all asymptomatic patients.

We assumed that the prevalence of COVID-19 ranged between 0 and 2.0% in the asymptomatic population (n = 1,000). We also assumed three scenarios of the diagnostic ability of the PCR test as: (A) high sensitivity of 80% and high specificity of 99%, (B) high sensitivity of 80% and low specificity of 90%, (C) low sensitivity of 50% and high specificity of 99%. Using these assumptions, we made a 2 × 2 table and calculated the net benefit as follows: (True positive/N – False positive/N*p/[1 − p]),[2,3] where p is the threshold probability of the hospital policy to treat the patients with positive results as infectious. Furthermore, p/(1 − p) in the calculation of net benefit means how many false-positive cases we are willing to accept to obtain the one true-positive case. For example, if the threshold is 1% (P = 0.01), all the patients whose probability of having COVID-19 is more than 1% should be isolated by the hospital policy, and 0.01/(1 − 0.01) means that 99 false-positive cases have to be accepted to isolate one true-positive case. We set the threshold as 1–10%. The details of calculating the net benefit are described previously.[2,3] Net benefit *N denotes the number of the patients who will benefit from true-positive cases adjusted to the harm of false-positive cases in this population. We determined the conditions that can obtain the adequate number of true-positive cases per 1,000 asymptomatic patients in various assumptions.

In the figure illustrating the results (Fig. 1), basically, in all assumptions of diagnostic ability, the net benefit showed a linear relationship with the prevalence, and the net benefit increased as the prevalence increased. If the prevalence is low (<1%), testing might be useless as the net benefit will be very low or even less than zero. In the assumptions in which PCR has high specificity of 99% (A and B), in order to find 10 true-positive cases/1,000 cases, high sensitivity (80%) with more than 1.3% in prevalence, or high prevalence (>2%) will be required. In contrast, in the assumption of low specificity (C, 90%), in order to obtain 10 true-positive cases/1,000 cases (1%), we will have to accept many false-positive cases (P = 1%, 99/1,000 cases), or high prevalence (>2%) will be required. This simulation indicated that the

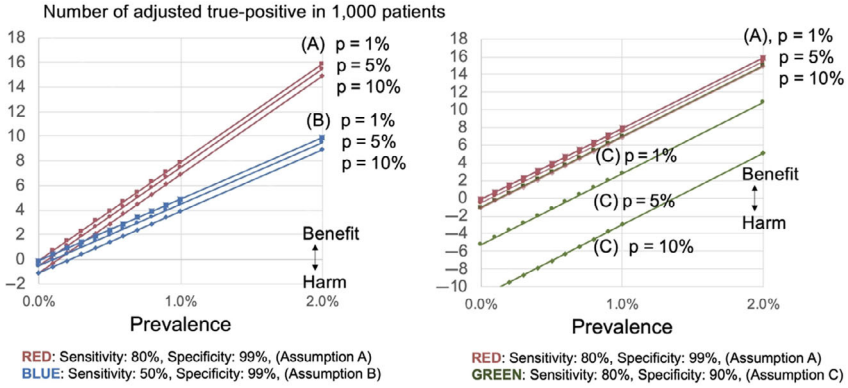

Fig. 1. Simulated net-benefit of polymerase chain reaction test for COVID-19 among asymptomatic patients in the emergency room. X-axis: Prevalence of COVID-19. Y-axis: Number of true-positive cases adjusted to harm of false-positive cases in 1,000 cases. The figure shows the net benefit as the number of true-positive cases adjusted to harm of false-positive cases in 1,000 cases in various assumptions (A–C). Generally, high prevalence or high diagnostic ability is necessary to obtain the adequate benefit of the test. In assumption C of low specificity (90%), if threshold probability (p) is 5% or 10% and low prevalence, the net benefit is less than zero, because the harm of false-positive cannot be accepted in this threshold.

benefit of PCR testing depends on the prevalence, diagnostic ability, and threshold probability. Therefore, it is essential to measure the prevalence of COVID-19 in the asymptomatic target population and understand the diagnostic ability and the hospital policy before discussing the pros and cons of PCR testing of all the patients admitted to the emergency department.

DISCLOSURE

Approval of the research protocol: This is a simulation study; thus, ethical approval is not applicable.
Informed consent: N/A.
Registry and the registration no. of the study/trial: N/A.
Animal studies: N/A.
Conflict of interest: None.

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